

Running head: WHEN IN DOUBT: DON'T GO OUT!

Warning: Swim at your own Risk.

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Līhu'e, Kaua'i, Hawai'i

November 2010

Dedicated to Heather Westphal and Tonya Cataldo

This applied research project is dedicated in the memory Heather Westphal and Tonya Cataldo who tragically lost their lives while swimming at Queens Bath on the island of Kauai on October 12th 2008. May their lives as loving wives and caring mothers not be lost in vain, but are remembered for championing community risk reduction efforts on the island of Kauai.

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

Signed: _____

Abstract

The Island of Kauai is the northwestern most island in the Hawaiian Island chain in the middle of the largest ocean in the world, the Pacific Ocean. Its beautiful white sand beaches surround the islands on every side. With all of this beauty and surrounded by water, the county of Kauai must deal with hard facts of drowning deaths.

The problem addressed is that despite current risk reduction efforts, the island of Kauai sees a high rate of marine drowning incidents each year. The purpose of this research is to conduct a detailed risk assessment of drowning incidents in coastal marine waters surrounding the island of Kauai.

Descriptive research was used to answer the following research questions: a) What similarities can be drawn from the coastal marine drowning incidents in Hawaii and the island of Kauai as it compares to global and national statistics?, b) What are the hazards and risks that are specifically associated with the coastal marine waters surrounding the island of Kauai?, c) What risk reduction programs has KFD and MSH implemented to address the coastal marine drowning incidents on Kauai?, d) What other risk reduction strategies can KFD and MSH employ to help reduce the number of drowning incidents associated with the marine waters surrounding Kauai?

Procedures used to answer the stated questions included a comprehensive literature of journals, websites, national, state and local statistics, personal interviews and conferences proceedings.

The research revealed that drowning incidents is an ongoing issue not only for the island of Kauai but, worldwide. Results found that, although it is a worldwide issue, drowning incidents on Kauai were considerably different. A majority of these differences were attributed to the geographic make up of the island, its location and being a tourist destination. Recommendations included educational, enforcement, engineering, emergency response and economic benefitting strategies.

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Introduction

In 2009, 15 people lost their lives in the near shore marine waters surrounding the island of Kauai. This total was second only to California State Parks which recorded 26 (USLA Lifeguards for life, 2010). Yet the population of California, 34 million, is more than 500 percent higher than Kauai, which stands at 64.5 thousand (U.S. Census Bureau, 2009). In addition to the total population on Kauai, the island averages 20 thousand visitors per day (Department of Business, economic development & tourism, 2010). These deaths occurred in spite of the efforts of the Kauai Fire Department (KFD) and other major stake holders (MSH) in Kauai County to prevent these accidental tragedies from happening.

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Descriptive research was employed to answer the following research questions:

1. What similarities can be drawn from the coastal marine drowning incidents in Hawaii and the island of Kauai as it compares to global and national statistics?
2. What are the hazards and risks that are specifically associated with the coastal marine waters surrounding the island of Kauai?
3. What risk reduction programs has KFD and MSH implemented to address the coastal marine drowning incidents on Kauai?

4. What other risk reduction strategies can KFD and MSH employ to help reduce the number of drowning incidents associated with the marine waters surrounding Kauai?

Background and Significance

The Kauai Fire Department is the western most fire department in the United States. It's located on the Island of Kauai, which is the northwestern most island in the Hawaiian Island chain in the middle of the largest ocean in the world, the Pacific Ocean. Hawaii as well as Kauai's is well known as a year round tourist destination. Its beautiful white sand beaches surround the islands on every side. A survey conducted by the Kauai Visitors Bureau (KVB) found out that one of the first things a visitor wants to do is jump into the warm inviting water. The survey also revealed that what first interested them to visiting the island of Kauai was the beaches, scenery, natural beauty, sunbathing and relaxation (S. Kanoho, personal communication, June 5, 2010).

Fire Department services were established on Kauai in 1939 operating out of five service stations with 30 gallon pumpers. By 1942 The County Civil Defense took control over fire department operations with 60 Firefighters and 7 fire trucks. Today the KFD serves its constituents from 8 stations, employing 137 career fire fighters personnel, responding to over 5000 calls a year, covering a land mass area of 622 square miles.

The Department's organizational structure is headed by the Fire Chief (FC), who is selected by an appointed fire commission. Directly under the fire chief is an appointed Deputy

Chief (DC) who supervises daily operations as well as assuming the duties of fire chief in his absents. An Administrative assistant supervises five office personnel.

Daily fire service operations are divided into 3 battalions. Each battalion consists of 48 career fire fighters working 24 hour shifts, each managed by a Battalion Chief (BC). In addition, each BC is assigned to supervision of one of three bureaus. The Training Bureau consists of a Captain and a firefighter III. The Prevention Bureau consists of a Captain and 3 firefighter III's. The Ocean Safety Bureau consists of a Supervisor IV, 3 Supervisor III, a training Supervisor and 40 life guards.

The Ocean Safety Bureau (OSB) was originally a division under the County of Kauai (COK) Parks and Recreation. In the early 60's the bureau started with one lifeguard tower situated at Poipu Beach Park with a staff that included 4 part time lifeguards. One lifeguard even doubled as the park caretaker. By 1990 the OSB had grown to 4 lifeguard towers and 4 full time lifeguards that utilized 12 foot rescue surfboards for rescue response. The towers were situated on beach parks on the north, south, east and west shores of the island. In 2001, the COK moved the management of the OSB out of Parks and Recreation and under the direct supervision of KFD. Through the guidance and strategic planning of KFD, the OSB has expanded and currently staffs 10, state of the art, fiberglass surveyor towers covering the coastline of Kauai from Kee beach on the north end, to Kekaha beach on the west end of the island. The Bureau is now staffed with 45 fulltime OSB personnel. The bureau also utilizes 11 pickup trucks, 8 all terrain vehicles (ATV) and 5 jet skis out fitted with rescue sleds. These figures reflect

the highest number of OSB personnel, enhanced rescue equipment and surveyor towers in operations in the history of the island.

Despite these advancements, the island of Kauai averages 7.5 marine drowning incidents a year or a total of 300 over a 40 year period from 1970-2009. This is a very alarming paradox. In that, with the increased risk reductions efforts that KFD's OSB have implemented over this time period, the COK still averages a high number of marine drowning incidents per capita each year. .

The mission statement of KFD's OSB is to provide a world class professional lifesaving service, educational programs, while protecting the environment and using the highest preventive measures for the island of Kauai.

Establishing a national focus on community risk reduction was the intent of the second course in the Executive Fire Officer Program, Executive Analysis of Community Risk Reduction (EACCRR). Community risk reduction involves both prevention and mitigations strategies. Where prevention deals with anticipating potential hazards within a community and facilitating interventions to prevent occurrences, mitigation deals with anticipating hazards but involves interventions to diminish adverse outcomes (National Fire Administration, 2009). This research project will specifically address community risk reduction efforts here on the island of Kauai, and also links itself with one of the United States Fire Administration's 5- year operational objective, which is to develop a comprehensive multi-hazard risk reduction plan for 2,500 communities.

Literature Review

A comprehensive literature review has been conducted to assist KFD in specifically addressing the risk reduction strategies for coastal marine water drowning incidents on the island of Kauai. Due to the specific nature of this research on community risk reduction, the literature review will focus on world and national trends as it pertains to Hawaii and more so the island of Kauai.

Historically, in the 1800s, swimming called bathing became an increasingly popular recreation. People from inland cities were attracted to our ocean shoreline to escape the summer heat. As water activities increased so did the drowning rate. By the early 1900s as many 9,000 people drowned each year nationally. Early prevention efforts included, installing life lines, which were ropes that were anchored on shore that extended to pole in the ocean. This proved ineffective, due to the fact that struggling swimmer couldn't hang on to the lifelines. In 1910, ironically, it was famed Hawaiian surfer and Olympic gold medalist, Duke Kahanamoku, who introduced the surfboard as a means to paddle out and assist struggling swimmers. Eventually, municipalities began to hire trained persons for water rescue. They were called lifeguards. Over time lifesaving devices were created by beach lifeguards. They included rescue buoys, rescue tubes, and the fore mentioned rescue board which is still commonly used today (American Red Cross, 1995).

Due to the lack of lifeguard presence, the Young Men's Christian Association (YMCA) developed a volunteer national lifesaving service in 1912. These training programs primarily emphasized personal water safety (American Red Cross, 1995).

In 1964, several members from the California surf lifeguard agency founded an organization known as the United States Lifeguard Association (USLA). Their intent was to enhance lifesaving efforts and drowning prevention, to standardize beach lifeguard practices, to educate the public about water safety and improve professionalism among lifeguard organizations. Major aquatic safety organizations in the United States continue to emphasize prevention rather than rescue as the primary method to reduce drowning incidents (USLA Lifegaurds for life, 2010).

The Merriam –Webster's dictionary defines drowning as suffocation by submersion in water. Accidents are defined as an event occurring by chance or unintentionally (Merriam-Webster Incorporated, 1997). The World Health Organization (WHO) defines drowning as the process of experiencing respiratory impairment from submersion/immersion in liquid (World Health Organization, 2000). Drowning is also classified by the Center for Disease Control (CDC) as unintentional injury death.

In 2000, an estimated 409,272 people drowned, which makes drowning the second leading cause of unintentional injury death globally after road traffic injuries according to the WHO. WHO goes on to state, that of these drowning deaths, 97% occurred in low and middle income countries. One third of all drowning occur in the Western Pacific Region. Among the various age groups, children under the age of 5 have the highest drowning mortality rates worldwide. Drowning in young children is often associated with a lapse in supervision. Overall

the male drowning rate is more than twice that of females. Studies also suggest these higher rates in males are due to increased exposure to water and riskier behavior, such as swimming alone and consuming alcohol before swimming and boating (World Health Organization, 2000).

In *Circulation*, the journal of the American Heart Association also stated that drowning accounts for more than one half million deaths worldwide. This number is probably a gross under-estimation because of underreporting. Another contributing factor is that the definition of drowning varies among reporting agencies. The lack of consistency makes assessment and analysis of reports difficult (Idris, A.H, Berg, R.A., Bierens, J., Bossaert, L., Branche, C.M., Gabrielli, A., et al., 2003)

The national per capita drowning rate is 15.5613 deaths per 1 million people or 1.5 per 100,000 people according to Nation master (NationMaster, 2010).

In fact drowning is the seventh leading cause of unintentional injury deaths for children and the second leading cause of all injury deaths in children aged 1-14. Recreational water settings including pools, spas/hot tubs and natural water settings such as lakes, rivers and oceans are where most of these injuries are taking place (Center for disease control and prevention, 2004).

The United States averaging 10 unintentional drowning deaths per day or a total of 3,443 in 2007. More than one in five fatal drowning victims are children 14 and younger. Males are 3.7 times more likely than females to die from unintentional drowning deaths. Nearly 30% of all children ages 1 to 4, who died from an unintentional death, were due to drowning. Drowning rates for African Americans across all ages was 1.2 times that of Whites. For American Indian

and Alaskan Native children the fatal drowning rate was 2.2 times higher than that of whites. Physical environment, such as access to swimming pools, and a combination of social and cultural issues, such as the valuing of swimming skills and choosing water related activities may also contribute to racial differences in drowning rates (Center for Disease Control and Prevention).

In a technical report, *Prevention of Drowning*, Weiss (Weiss, 2010) reveals that from 2000-2006 drowning was the second leading cause of unintentional injury death among children age 1-19 years of age in the United States. In that same period, 3 times as many white children and adolescents died from drowning as compared to African American of the same age. Yet the drowning rate was actually higher in African American children than white, 1.95 versus 1.29 per 100,000. Drowning deaths in boys is commonly twice as much as girls, but in adolescents it jumps to nearly 10 times as much. Overall the highest drowning rates were in African American boys age 15 to 19, 4.46 deaths per 100,000. Although the majority of white children drowned in residential pools, African American children were more likely to drown in public, hotel or motel pools. Some of reasons we see this high rate in African American teenagers could be attributed to poor parental swimming skills, lack of early training, poor swimming ability and lack of life guards at hotel and motel pools.

The report goes on to state, that among all causes of unintentional injury deaths in the United States, drowning shows the greatest seasonal variation. Nearly two thirds of all drowning death victims age 15 and younger occurred between the months of May through August, with the days of Saturday and Sunday disproportionately high.

Weiss noted that age was an important determination of drowning location. Using a national study of 1420 drowning deaths on victims 20 year of age and younger, it was revealed that 47% of the drowning deaths occurred in fresh of water, such as rivers, creeks, canals, lakes and ponds. Artificial pools accounted for 32% and only 4% of drowning deaths occurred in salt water. Nearly 78% of infant drowning deaths took place in bathtubs or large buckets. In another national study more than half or 51% of the drowning deaths of children age 0-4 occurred in swimming pools. With slightly older children, ages 5-14, the location of the drowning was more apt to be in a natural body of water instead of a swimming pool

Some of risk factors that contribute to the drowning rate listed in this report were the fore mentioned socio-demographics, such as age, gender and race. Other factors were locations, lapses in adult supervision, swimming ability, underlying medical conditions and alcohol intake. In fact 30 to 70 percent of swimming and boating fatal drowning victims had a measurable blood alcohol concentration (Weiss, 2010).

In the United States, drowning is a leading cause of injury-related deaths in children younger than 20, with more than 1400 deaths in the year 2000. Ninety one percent of these unintentional deaths were not related to boating incidents states Brenner in her report, *Prevention of Drowning in Infants, Children and Adolescents* (Brenner R. A., 2003).

Brenner (Brenner R. A., 2003) writes, from 1990-2000 drowning deaths in the United States was the second leading cause of unintentional deaths among children ages 1 through 19. It was also the leading cause of injury death and the second leading cause of death overall, in toddlers 12 to 23 months of age. Because drowning injuries occur disproportionately among youth, it is one of the leading causes of," years of potential life lost" in this age group. Like

Weiss, Brenner also list contributing risk factors as being socio-demographics, geographical, location and circumstances, lapses in adult supervision, alcohol intake, swimming ability and underlying medical conditions.

Safe Kids (Safe Kids, 2010) reported that each year more than 830 children ages 14 and under die as a result of unintentional drowning and another 3600 are injured due to near-drowning incidents nationwide. Children under the age of 4 have the highest drowning death rate, nearly two times greater than other age groups. Male children have a drowning rate twice that of females and African Americans children ages 5-14 have a drowning rate three times greater than their white counterparts. Safe Kids also reported that home swimming pools are the most common sites for these drowning deaths. In the summer, between May and August, drowning deaths among children increase 89 percent over the rest of year. Parental or caregiver supervision was claimed in nearly 9 out of 10 deaths.

In an article titled, *Where Children Drown*, Brenner (Brenner R. A., 2001) states that drowning is the second leading cause of unintentional death among children ages 1 to 19 years of age. Fifty five percent of infant drownings were in bathtubs. Among children ages 1 to 4, 56% of drownings were in pools and 26% were in other bodies of fresh water. In older children, 63% of drownings were in natural bodies of fresh water. Site-specific drowning rates varied by race. After the age of 5, the risk of drowning among African Americans males was 4 times greater than that of white males.

Statically males are nearly four times more likely to drown than women. Howland (Howland, 1996) lists a number of factors. First, men are exposed to greater number aquatic activities where submersion is possible. Young men are more apt than young women to take

risks in aquatic settings, placing themselves in riskier situations. Men over estimate their swimming ability and finally men consume more alcohol around aquatic settings. Alcohol was particularly dangerous because many become men overconfident about their aquatic skills.

Nationally, there are several consistent approaches used in the prevention of drowning. When looking at Haddon injury prevention matrix, the key to safety interventions was changing the environment, the individual at risk or the agent of injury. For drowning prevention, the environment and the individual are the key targets. Because there is no single strategy to prevent drowning deaths, experts generally recommend that a multiple layers of protection strategies be used. Prevention strategic layers might include environmental changes such as adult supervision, pool fencing, pool covers, water entry alarms, lifeguards, and cardio pulmonary resuscitation (CPR) training. Prevention strategies directed at the individual, could include swimming and survival skill training or use of personal flotation devices (Weiss, 2010).

The Center for Disease Control (CDC) (Center for disease control and prevention, 2004) list other prevention strategies that include the buddy system, which is swimming with a partner, selecting swimming sites that have a lifeguard, avoid alcohol and not using air-filled or foam toys in place of life jackets. Other prevention tips that the CDC recommend are using U.S Coast Guard- approved life jackets, knowing the local weather conditions or forecast, watch for wave and signs of rip currents and obeying all warning signs.

WHO (World Health Organization, 2000) broke down their prevention strategies into four interventions. The interventions listed were removing the hazard, creating barriers, protecting those at risk and countering the damage. Removing the hazard consisted of draining unnecessary accumulations of water in baths, ponds, buckets and other containers. Creating

barriers, consisted of building flood control embankments, implementing and enforcing mandatory isolation fencing for swimming pools, encouraging fencing around rural homes in proximity to water, encouraging use of grills over water wells and where possible, fence around rural fish ponds and construction ditches. Protecting those at risk consisted of promoting “learn to swim” programs, increasing access to swimming pools to promote “learn to swim”, increasing the awareness of the need to supervise children, instructing children not to enter fast moving streams and not to swim alone, training lifeguards for regular deployment in supervised swimming locations, increasing education in boat safety regulation and finally legislating against alcohol consumption while boating. Countering the damage included increased CPR training for the general community.

The literature review will now look at trends, hazards, risks and the risk reduction strategies for coastal marine water drowning incidents in Hawaii and the island of Kauai.

Prior to 1970, tourism on Kauai was moderate compared to Oahu where Waikiki was the premier destination. Due to this fact, the majority of the marine ocean drowning incidents involved residents, commonly less than 3 per year. Today more than 52% of the total marine drowning incidents in Hawaii are visitors (State of Hawaii Department of Health, 2010)

From 2001-2008 the state of Hawaii had a total of 497 drowning incidents, with an average of 62 drowning deaths each year. When looking at the environment in which these incidents occurred, 416 of these drowning incidents occurred in coastal marine waters nearly 83%. Pools drowning incidents totaled 39, or 8%, fresh water totaled 23 or 5% and bathtubs accounted for 19 total or 4% as shown in appendix A (State of Hawaii Department of Health, 2010).

From 2000 to 2009 there were a total of 512 coastal marine water drowning incidents in the state of Hawaii. The annual average was 51. The drowning victims were nearly equally divided between Hawaii residents (48%) and non-residents (51%). Of the total drowning victims, 84% were males. Ninety seven percent of the victims were 18 years of age and older. Of that ninety seven percent of drowning victims older than 18 years, 53% of the victims were between the ages of 40 to 65 years of age. The annual totals peaked in 2005, then decreased for two years, before leveling off the last three years as illustrated in appendix B.

For the island of Kauai, from 2000 to 2009 there were a total of 135 drowning incidents. Coastal marine waters accounted for 119 deaths or 88%, fresh water, 10 deaths or 7%, pools 5 deaths or 4% and bathtub, 1 death or 1% (Appendix C) (County of Kauai Police Department, 2010).

The incidents that were recorded did show some seasonal trends with 41% of the drowning incidents occurring between the months of May through August. Weekend drowning incidents were also identified as a trend with nearly 41%. Of those weekend drowning incidents, 48% of the victims were Hawaii residents. Eighty one percent of the drowning incidents taking place between the daylight hours of 0830 hours to 1730 hours (Appendix D).

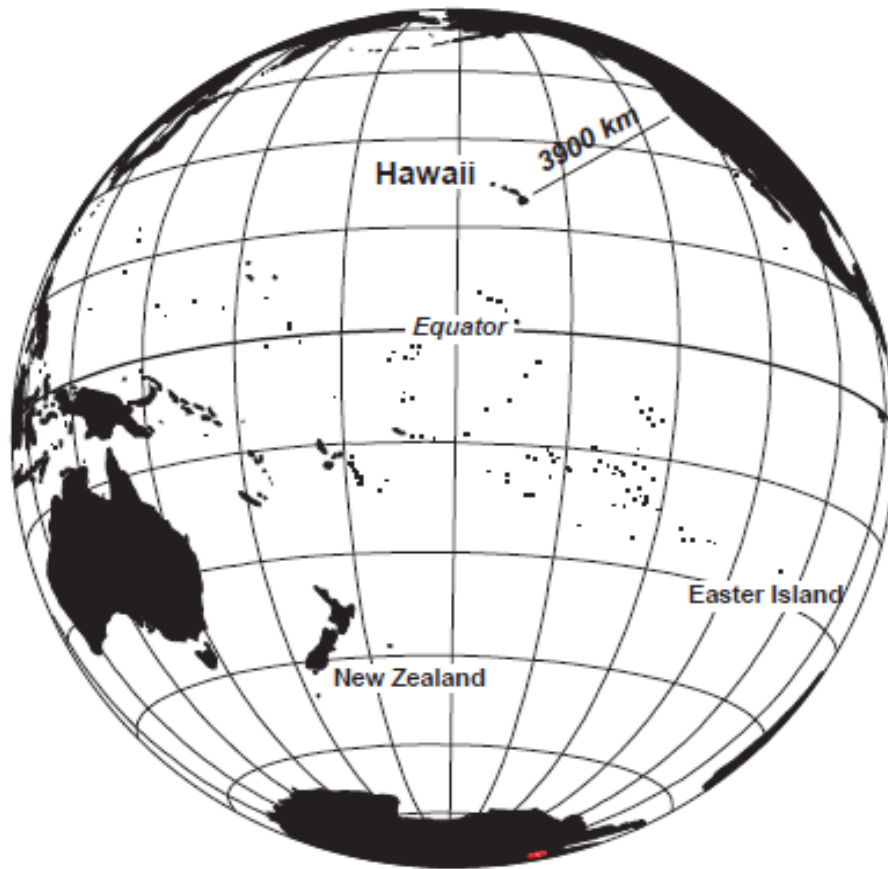
The activities that coastal marine water drowning incidents were classified in included boating accidents, shoreline fishing, scuba, free diving, snorkeling, swimming, surfing, picking opihi, being swept in the ocean, other and unknown. Two hundred twenty five or nearly half of the total 521 coastal marine water drowning incidents from 2000 to 2009 occurred while swimming or snorkeling. Of the 225 drowning victims, 165 of those were non residents or visitors to the islands as seen in appendix E (State of Hawaii Department of Health, 2010).

In comparison of the annual average rate, per million, of coastal marine water drowning on the four major islands, it was revealed that drowning rates of residents and non-residents varied by county. On a per capita basis, drowning rates of non-residents are roughly 15 times greater than that of residents. Residents of Hawaii County have the highest rates of coastal marine water drowning, considerably higher than Maui and Oahu counties. Kauai County had the highest rate of drowning incidents for residents and non-residents combined, with non-residents significantly higher as depicted in appendix F (State of Hawaii Department of Health, 2010).

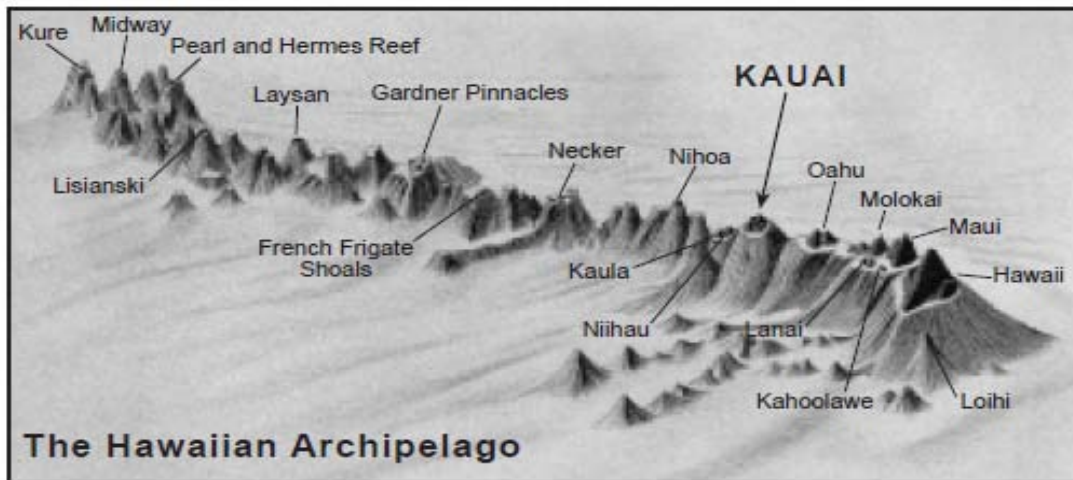
From 2000-2009 the County of Kauai experienced a total of 119 coastal marine water drowning incidents, an average of almost 12 a year (County of Kauai Police Department, 2010). One hundred three or 87% of these victims were non-residents. Eighty nine or 75% of those victims were either swimming or snorkeling (Appendix G).

The police records also revealed that 101 or 85% of the drowning victims were males. The average age of the victims were 45 years of age, with 64% of these victims between the ages of 30-60. Sixty seven percent of these incidents occurred on beaches that were classified as accessible as opposed to remote beach sites (County of Kauai Police Department, 2010).

Charles Blay (Blay, 2008) a geoscientist with a Ph.D. in geology from Indiana University and founder of The Edge of Kauai Investigation, acknowledged some of specific hazards associated to the island of Kauai from a geological standpoint. He pointed out that Hawaiian Islands sits in the middle of the North Pacific Ocean, making the Hawaiian Islands the most isolated yet populated land mass in the world (Figure 1).

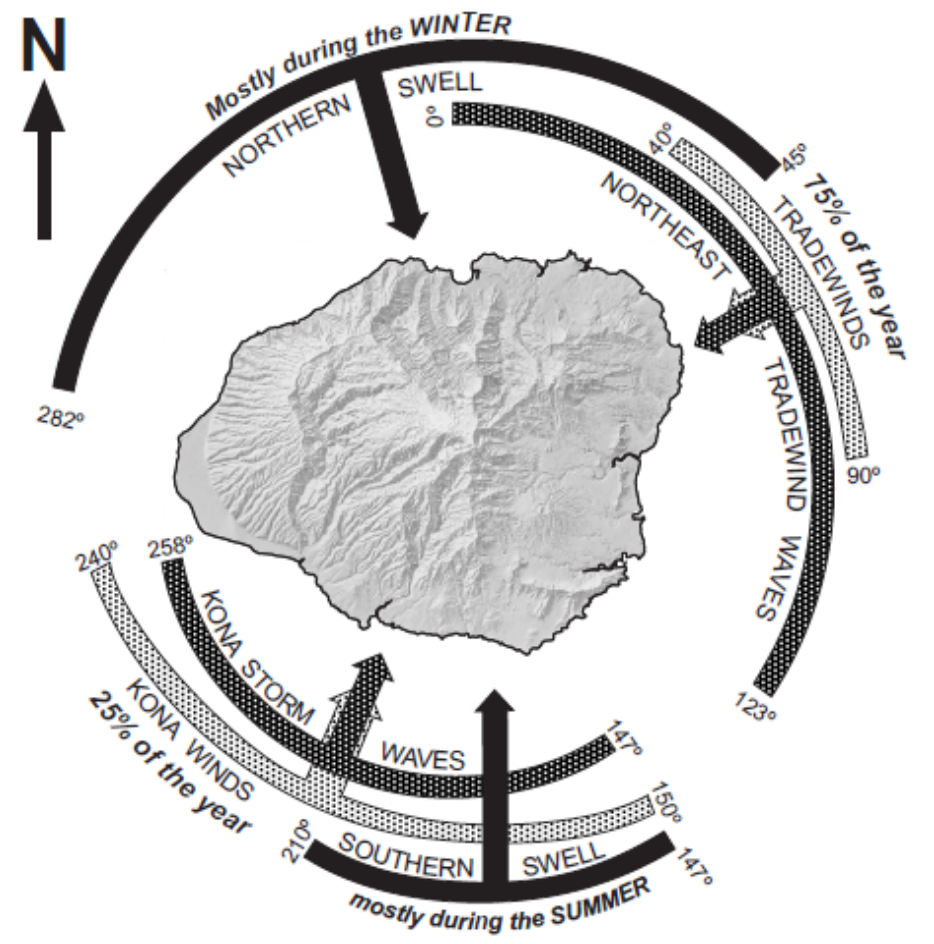
Figure 1

Kauai like all the other islands in the Hawaiian Archipelago are massive shield volcanic mountains lying nearly 16,000 feet below sea level with less than 5% of the volcanic land mass above sea level (Figure 2).

Figure 2

The shield volcanic mountains create very shallow shelf areas around the islands, so water depths around the islands increase rapidly as you move offshore due to the sloping nature of these shield volcanic mountains. Such slopes have minimal effect on major wave systems that impact various sides of the islands throughout the year. In the seven winter months of October through April, north facing shores of all the islands typically sees sets of large waves or commonly referred to as swells, produced by North Pacific storms. During the 5 summer months of May through September south facing shores of the islands sees smaller but still powerful ocean swells generated by winter storms in the vast southern hemisphere. East facing shores experience almost year round, wind generated waves created by the prevailing trade winds that normally gust through the island chain (Figure 3)

Figure 3



Dr Blay goes on to address the fact that Kauai's highly variable geomorphic and marine bathymetric shorelines adds to the complexity of the island's water safety situation. No two beaches or rocky shoreline locations on Kauai, whether remote or easily accessible are the same.

In addition to the powerful breaking waves, many beaches have strong currents that add to the specific hazard at any particular location. There are typically rip and shoreline currents which occur near shore, but deep reef channels create seaward directed currents. Strong currents at river mouths can also form especially during periods of high

fresh water discharge. So a complex of several hazardous conditions can affect a specific location, plus daily conditions vary and change constantly due to season, tides, wave swells and winds.

Kauai Explorer (Kauai Explorer), a KFD sponsored website, informs readers to the specific hazards such as changing ocean conditions, rip currents and seasonal surf trends associated with the marine waters surrounding the island of Kauai. It also posts the current oceans conditions for that day, including surf heights, wind speed, visibility and tides at different lifeguarded beaches around the island of Kauai and suggest recommended beaches for the day. The website goes on to inform its reader on some risk reductions strategies such as swimming at lifeguarded beaches, heeding warning signs, use a buddy system when swimming, constantly monitoring ocean conditions, knowing that waves comes in sets with intervals averaging 15 minutes apart, not fighting a rip current instead going with it and finally, “when in doubt don’t go out”.

Welborn (Welborn, 2009) concurs with Blay and the Kauai Explorer that hazards related to the island of Kauai are very specific. Welborn states that beaches, reefs and shorelines change drastically as move around the island. He lists surf patterns, northeasterly trade winds, tidal movement, reef formation and location of beaches around the island all as contributing factors to hazardous conditions that can dominate a specific shoreline. Welborn listed risk reduction strategies as “knowing what the locals know”. These strategies included keeping a close watch on ocean conditions as conditions change quickly, even hourly, knowing that winds moves the ocean so expect currents and surface chop to increase as wind increases, looking for calm conditions in protected coves and

bays, having tidal awareness knowing that more surf moves into locations protected by coral reefs with increasing tides, watching for periodic large set waves that wash up on beaches and rock ledges and finally asking information from a lifeguard or local because they are probably your best single source of weather and ocean conditions.

The high number of coastal marine water drownings over the past 40 years has motivated numerous individuals both private and governmental to investigate risk reduction strategies.

In a personal interview with Kalani Vierra, KFD's Ocean Safety Bureau Supervisor, Kalani described some of the risk reduction strategies that his bureau currently uses to address coastal marine water drownings. The first was emergency response. The OSB has 10 lifeguard towers covering beaches from the north end of Kauai to the west end. The north tower, Ke'e, is funded by the State, covering man power, equipment and vehicles. They also utilize four jet skis, positioned around the island depending on ocean conditions for that day. OSB uses summer hires and 19 hour workers to help cover seasonal staffing. At the guarded beaches, they use warning signs and direct interventions as risk reduction strategies. Educational risk reduction strategies include school visitations, career days, public service announcements, having ocean safety signs and brochures situated at the airport and hotels and ocean safety videos played on the Kauai visitor's information channel and sponsoring an educational website called Kauai Explorer. Finally OSB conducts an annual junior lifeguard program, for children ages 13-17, along with CPR and first aid training (K. Vierra, personal communication, August 4, 2010).

In a personal interview with Monty Downs, M.D., E. R. Physician at Wilcox Hospital, Dr. Downs stated that as an emergency room physician he saw too many tragic outcomes over his long tenure that motivated him to get involved. Part of his involvement include President of the Kauai Lifeguard Association and Co- chair of the Kauai Water Safety Task Force which is a citizen group that includes Wilcox Memorial Hospital emergency room physicians and nurses that meet monthly to develop strategies for Kauai's current water safety issues. One of it more recent risk reduction strategies, with help from the Kauai Rotarians, was placing rescue tubes on pole stands at various high risk beaches around Kauai. He stated as of September 2010, they have had 25 rescues as a direct result of the rescue tubes. Although rescue tubes assist emergency response, Dr. Downs still believes that risk reductions lies in education (M. Downs, personal communication, October 2, 2010).

The water awareness/visitor education or WAVE Project can be a cornerstone of risk reduction strategies for coastal marine water drowning on Kauai states Pat Durkin in a personal interview (P. Durkin, personal communication, July 24, 2010). Pat Durkin is the project director for the WAVE Project. The Project's strategy was to raise the quality of beach safety information that visitors receive. Durkin noted that as a community, we have reached a critical juncture in drowning prevention. We have professional lifeguards, good leadership, concerned citizens grounded in the mission, County Government seeing the value of safe beaches and a visitors bureau that stands behind aggressive drowning risk reduction strategies. MSH such as resorts, timeshares, vacation rentals, bed &

breakfast and activities desks need to be part of solution because these MSH have the greatest leverage over what visitors from day to day and they have the most to lose.

So the WAVE Project with assistance through a grant from the Office of Economic Development has trained 226 participants among various resorts and agencies on ocean safety. Durkin stated the primary target of this program will continue to be the visitor industry, but it will continue to take efforts from concerned citizens like the Kauai Water Safety Task Force, the Kauai Visitors Bureau, the Mayor's Office and the Kauai Fire Department to make a difference on the coastal marine water drowning on Kauai.

The 2010 State of Hawaii Drowning Prevention and Ocean Safety Conference (Kauai Lifeguard Association, 2010) was held on the island of Kauai this year. This conference is the premier venue for addressing risk reduction strategies for coastal marine drownings in the State of Hawaii. The conference attendees included Ocean Safety Supervisors, Fire Chiefs, Emergency Medical Service (EMS) and Department of Health personnel from the four counties, Honolulu, Maui, Kauai and Hawaii County, MSH such as Hawaii Tourism Authority, The Kauai Visitors Bureau and hotel managers and concerned citizen groups.

Guest speakers included Lenore Horowitz, author of the *Kauai Underground Guide*, Rebecca Robinson, from the Jabari project in Chicago and Peter Davis, Chief Lifeguard and Secretary General of the International Life Saving Foundation from Galveston Texas.

The open forum discussion on Drowning Prevention proved most valuable for addressing innovative risk reduction strategies for coastal marine drownings on Kauai

and the State of Hawaii. The majority of the suggestions that were discussed focused on ocean safety education awareness and different ways to disseminate the message.

Some of the strategies suggested were using the social media such as face book, twitter, cell phone updates and travel websites to get the Hawaii ocean safety message out. Another suggestion focused on playing ocean safety videos with famous faces and recognizable waterman at airports, car rentals, shopping centers, lobbies, and the Hawaii visitor's channel in the hotel room televisions.

Other strategies focused on beach rating systems with review boards or committees that provide seals of approval for Hawaii's and Kauai's beaches. Having educational kiosk listing risks, hazards and drowning statistics positioned in beach parking and closing access to beaches to discourage beach goers.

Emergency response strategies included having more lifeguard surveyor towers with jet skis and a dedicated county rescue helicopter.

On the physiological front, studies have been presented on the possibilities of cooling down near drowning victims by applying full body ice packs in an attempt to slow the deteriorating neurological body functions (M. Downs, personal communication, October 2, 2010).

The final suggested strategy dealt with privately published guidebooks where many visitors get information on what beaches to visit. It was suggested that hazards associated with specific beaches be fully disclosed and require or encourage a 1 page disclosure statement.

In summary, sources that were researched undoubtedly revealed that drowning incidents are problematic worldwide, making drowning the second leading cause of unintentional death. This literature review clearly demonstrates the considerable community risk associated with marine waters surrounding the island of Kauai.

Procedures

The primary method of research used to address the high rate of marine water drowning incidents surrounding the Kauai was descriptive. This research utilized descriptive statistics to conduct a detailed risk assessment of this drowning problem. All procedures were focused on answering the four stated research questions. The first was what similarities can be drawn from the coastal marine drowning incidents in Hawaii and on the island of Kauai as it compares to global and national statistics? Second, what are the hazards and risks that are specifically associated with the coastal marine waters surrounding the island of Kauai? Third, what risk reduction programs has KFD and MSH implemented to address the coastal marine water drowning incidents on Kauai? Fourth, what other risk reduction strategies can KFD and MSH employ to help reduce the number of drowning incidents associated with the marine waters surrounding Kauai?

The literature review was started at the National Fire Academy's Learning Resource Center (LRC). The key word searches that were used were drowning and submersion. The LRC provided a foundation of data to establish that drowning incidents is a problem experienced worldwide. To supplement this data, internet searches on drowning and data retrieved from state and local agencies such as the Hawaii State

Department of Health and the Kauai Police records management system were used to help answer research question number one.

Once this data was obtained, the literature review focused specifically on the island of Kauai to help answer research questions 2, 3 and 4. This author benefitted by attending two separate conferences. The first was 2008 United States Lifeguard Association Board of Directors/ Educational Fall Conference and the second conference was the 2010 State of Hawaii Drowning Prevention and Ocean Safety Conference. These two conferences provided valuable insight as well personal contact to experts in the field of ocean safety and risk reduction.

To answer the second research question on the specific hazards and risks associated with coastal marine waters surrounding the island of Kauai, this author utilized the Kauai Explorer website and the Kauai Ocean Safety Guide. But what proved most valuable was a report presented at the 2008 United States Lifeguard Association Board of Directors/ Educational Fall presented by Charles Blay (Blay, 2008) a geoscientist with a Ph.D. in geology from Indiana University and founder of The Edge of Kauai Investigation, titled *Drowning Deaths in the Near Shore Waters of the Island of Kauai/Hawaii: A Case Study of History and Water Safety Response*.

Efforts to answer the third research question on what risk reduction programs has KFD and MSH implemented to address the coastal marine water drowning included three personal interviews. One with KFD's OSB supervisor Kalani Vierra, the other two were with emergency room physician, Dr Monty Downs, and the WAVE Project director, Pat Durkin.

The final research question focused on what other risk reduction strategies can KFD and MSH employ to help reduce the number of drowning incidents associated with the marine waters surrounding Kauai. Due to the wide range of attendee at the 2010 State of Hawaii Drowning Prevention and Ocean Safety Conference, the open forum discussion on Drowning Prevention proved to be the ideal venue to assemble new risk reduction strategies for the Island of Kauai.

Although much of the data utilized in this research is secondary, it can be assumed that all documents and reports used in this research were collected in an honest, unbiased and accurate approach. The primary data such as interviews and conference proceeding were done in same fashion.

Limitations affecting this research are primary attributed to fact that there isn't a standard definition for drowning among reporting agencies. The lack of consistency makes assessment and analysis of reports difficult. In particular, reporting in Hawaii only considered whether victims were residents or non residents and not listing nationality. Also, due to the high rate of drowning in children nationally most of the statistics focused on that age group. Intrinsic factors such as preexisting health issue and secondary drowning also may also affect the accuracy of reporting.

Definitions of Terms

Ocean swells: A long wave on water that moves continuously without breaking.

Trade winds: movement of air toward the equator, from the NE in the Northern Hemisphere and from the SE in the Southern Hemisphere Rip Currents: Narrow, jet like

stream of water that flows sporadically seaward for several minutes, in a direction perpendicular to a beach.

Secondary Drowning: death or the terminal state resulting from acute insufficiency of the oxygen supply to the brain and other tissues when the air passages are filled with fluid.

Results

The purpose of this research was to conduct a detailed risk assessment of drowning incidents in coastal marine waters surrounding the island of Kauai. The following research questions that were initially posed were answered as a result of this descriptive research.

1. What similarities can be drawn from the coastal marine drowning incidents in Hawaii and the island of Kauai as it compares to global and national statistics?

The research revealed that globally drowning incidents are the second leading cause of unintentional death. Males are twice as likely to drown as females due to increased exposure and riskier behavior (World Health Organization, 2000).

Nationally the drowning rate is 15.6 deaths per million people or 1.5 per 100,000 (NationMaster, 2010). From 1990-2000 drowning deaths in the United States was the second leading cause of unintentional deaths among children ages 1 through 19. It was also the leading cause of injury death and the second leading cause of death overall, in toddlers 12 to 23 months of age. Boys are twice as likely to drown as girls (Brenner R. A., 2003) (Center for Disease Control and Prevention) (Weiss, 2010). The United States averaging 10 unintentional drowning deaths per day or a total of 3,443 in 2007. More than one in five fatal drowning victims are children 14 and younger (Center for Disease Control and Prevention).

When compared with Hawaii statistics, Hawaii drowning rate is 35.9 deaths per million people more than double the national average (Appendix 4). From 2000-2009, males are accounted for 84% of the drowning deaths and the 97% of the victims were 18 years and older with 53% between the ages of 40 to 65 (Appendix 2) (State of Hawaii Department of Health, 2010).

The island of Kauai averages 100.8 deaths per million people more than six times the national average (Appendix 4). Between the years 2000-2009, 101 or 85% of the drowning victims were males with an average age of 45 years, 64 % of these victims were between the ages of 30-60 for the years (County of Kauai Police Department, 2010).

Nationally, age was an important determining factor of drowning location. In victims 20 years and younger, 47% of the drowning incidents occurred in fresh water, such as rivers, creeks, canals, lakes and ponds, 32% in pools and only 4% in salt water. Seven eight percent of infants deaths occurred in bathtubs and large buckets, in children 0-4 years of age 51% occurred in swimming pools (Weiss, 2010).

Brenner (Brenner R. A., 2001) stated that 55% of infants drowned in bathtubs, fifty six percent of children ages 1-4 drowned in pools and 63% of older children drown in natural bodies of fresh water.

Of the 503 total drowning incidents for the State of Hawaii from 2000-2008, 416 of these were in coastal marine waters, nearly 83%. Pool drownings totaled 39 or 8%, fresh water 23 or 5% and bathtubs totaled 19 or 4% (State of Hawaii Department of Health, 2010).

Kauai had a total of 135 total drowning incidents from 2000 -2009, 119 or 88% occurred in coastal marine waters, 10 or 7% in fresh water, 5 or 3.7% in pools and 1 in a bathtub (County of Kauai Police Department, 2010).

Swimming or snorkeling activities accounted for nearly half of the coastal marine water drowning incidents in Hawaii from 2000-2009 and 75 % on the island of Kauai (County of Kauai Police Department, 2010) (State of Hawaii Department of Health, 2010).

Seasonal variations in drowning incidents both nationally and in Hawaii increase between the months of May and August, with weekend's days disproportionately high (Weiss, 2010) (State of Hawaii Department of Health, 2010).

Risk reduction strategies globally were broken down into four interventions. First was to remove the hazard, such as draining unnecessary accumulation of water in buckets, bathtubs, ponds and other containers. Second creating barriers, such as building flood control embankments, fencing ponds and ditches, pools fencing and covers and grills over water wells. Third was protecting those at risk, such as promoting "learn to swim" programs, increasing awareness of adult supervision, training more lifeguards, increasing boating education and finally legislating against alcohol consumption while boating (World Health Organization, 2000).

Nationally, risk reduction strategies preferred a layered approach, using multiple strategies in prevention efforts. These strategies included those listed by WHO and in addition more CPR and survival skills training, use of U.S. Coast Guard approved life jackets, using a buddy system when swimming and avoiding alcohol, knowing the local weather conditions or

forecast, watching for wave and signs of rip currents and obeying all warning signs (Weiss, 2010)(Center for disease control and prevention, 2004).

When comparing these risk reduction strategies to Hawaii and Kauai's risk reduction strategies, it was revealed that some strategies were consistent such as having trained lifeguards, heeding warning signs, avoiding alcohol, using the buddy system when swimming and knowing the local weather and surf conditions.

Additional risk reduction strategies that were utilized primarily focused on the educational message of ocean safety awareness. These educational strategies are targeted at residents, visitors and MSH through different programs and delivery methods (Kauai Explorer) (Welborn, 2009).

2. What are the hazards and risks that are specifically associated with the coastal marine waters surrounding the island of Kauai?

The specific hazards and risks associated with Kauai start with geological make up and position of the Hawaiian archipelago in the northern Pacific Ocean. Hazards such as seasonal ocean and trade wind swells, rip, shoreline and river mouth currents, changing tides, changing weather conditions and differing shorelines can all be attributed to the geological make up and global position of the island Kauai. All these hazards can affect an otherwise calm ocean setting and within minutes change it into a dangerous situation for any beach goer (Blay, 2008) (Kauai Explorer) (Welborn, 2009).

3. What risk reduction programs has KFD and MSH implemented to address the coastal marine drowning incidents on Kauai?

Risk reduction programs that KFD has implemented starts with their OSB. According to Kalani Vierra, OSB supervisor, (K. Vierra, personal communication, August 4th, 2010), the OSB has 10 fully staffed lifeguard surveyor towers covering the selected beaches, seasonal staffing and 4 jet skis supplement emergency response. Warning signs and direct interventions are also used. Educational efforts include public service announcements, safety videos played on local visitor's information channel, ocean safety signs and brochures placed at airports, hotels and vendor stands, co- sponsoring an ocean safety educational website called *Kauai Explorer* , school visitations, career day participation, community CPR and 1st aid training and finally conducting an annual junior lifeguard program.

MSH have also contributed to risk reduction efforts, such as the WAVE project headed by Pat Durkin (P. Durkin, personal communication, July 24, 2010). This program trains employees from various hotels, condominiums and timeshare establishments' in water safety awareness, so they can give informed advice to their guests.

Dr. Monty Downs, from the Kauai Lifeguard Association and Kauai Ocean Safety Task Force (M. Downs, personal communication, October 2, 2010) recently implemented rescue tube program has already had 25 save to date from its inception in 2009.

The fore mentioned Kauai Explorer website has also been a risk reduction strategy that many MSH can take credit for.

4. What other risk reduction strategies can KFD and MSH employ to help reduce the number of drowning incidents associated with the marine waters surrounding Kauai?

The literature review suggested other risk reductions strategies that KFD and other MSH could employ to address the rate of drowning incidents on Kauai. Most of the strategies focused

on the ocean safety awareness message and the best methods to deliver it. Methods of delivery included using social media such as face book and twitter, using cell phone updates and travel websites. Placing educational kiosk listing risks, hazards and drowning statistics positioned in beach parking lots. Updating the ocean safety video using famous faces and recognizable waterman and continue to playing it at different venues. Another strategy discussed was requiring privately published guidebooks to include safety awareness messages in books.

Enforcement strategies included limiting or closing access to dangerous beaches, even if it is seasonal or based on conditions for that day.

Emergency response strategies included having more lifeguard surveyor towers with jet skis and a dedicated county rescue helicopter (Kauai Lifeguard Association, 2010).

The engineering strategy discussed was cooling down the body temperature of the near drowning victim to delay the neurological deterioration of the victim (M. Downs, personal communication, October 2, 2010).

Discussion

While conducting this descriptive research for the problem stated, that despite current risk reduction efforts, the island of Kauai sees a high rate of marine drowning incidents each year, the researcher gained valuable insight on this ongoing issue.

The purpose of this research was to conduct a detailed risk assessment of drowning incidents in coastal marine waters surrounding the island of Kauai. In an effort to accomplish the stated purpose, the researcher posed four research questions.

In discussing the first question on what similarities can be drawn from the coastal marine drowning incidents in Hawaii and the island of Kauai as it compares to global and national statistics? The similarities revealed in this research included the fact that drowning deaths is a dilemma globally, nationally as well as in Hawaii and Kauai, there is a higher percentage of males victims and statistics show some seasonal trends with drowning incidents increasing between the months of May through August and weekends (Brenner R. A., 2003) (Center for Disease Control and Prevention) (Weiss, 2010) (State of Hawaii Department of Health, 2010).

Yet this study has shown that Kauai has a drowning rate nearly six times the national average, 100.8 versus 15.6 per million people (NationMaster, 2010) (State of Hawaii Department of Health, 2010).

The research continued to show very contrasting statistics such as age of victims and location of incident. Nationally, children and young adults 20 years and younger are the largest at risk group. Forty seven percent of the drowning deaths occurring in fresh water, 32% in pools and only 4% in salt water (Brenner R. A., 2003) (Center for Disease Control and Prevention) (Weiss, 2010).

Hawaii statistics revealed that from 2000-2009, ninety seven percent of the victims were 18 years of age and older, with 53% of that total were between the ages of 40 to 65. Eighty three percent of the drowning deaths occurring in coastal marine or salt water, 8% in pools, 5% in fresh water and 4% in bathtubs (State of Hawaii Department of Health, 2010).

In the same time period, Kauai statistics showed 97% of victims 18 years of age and older, 64% of victims between the ages of 30-60 and eighty eight percent of the drowning deaths

occurring in coastal marine waters, 7% in fresh water, 3.7% in pools and 1% in bathtubs (County of Kauai Police Department, 2010).

The uniqueness of the Hawaiian Islands and specifically the island of Kauai may be contributing factors to the contrasting statistics. This is where research question 2 became pertinent in completing the risk assessment for the drowning incidents in coastal marine waters surrounding the island of Kauai.

The second research question posed, dealt with the specific hazards and risks that are associated with the coastal marine waters surrounding the island of Kauai. The most revealing information on the specific hazards and risks associated with Kauai was presented by Charles Blay (Blay, 2008) a geoscientist with a Ph.D. in geology from Indiana University. Blay stated that the geological make up and position of the Hawaiian archipelago in the northern Pacific Ocean had the greatest impact on the specific hazards and risks that are associated with the island of Kauai.

Hazards such as seasonal ocean and trade wind swells, rip, shoreline and river mouth currents, changing tides, changing weather conditions and differing shorelines can all be attributed to the geological make up and global position of the island Kauai (Blay, 2008) (Kauai Explorer) (Welborn, 2009).

When further examining the statistics on drowning incidents on Kauai, not only did the age of victims and location of drowning stand out, but the percentage of visitors drowning did. Nearly 87% were non residents or visitors (Appendix 7) (County of Kauai Police Department, 2010). This may also be attributed to the location, as Kauai is a prime tourist destination.

Question 3 and 4 dealt with what risk reduction programs has KFD and MSH implemented and what other risk reduction strategies can be implemented to address coastal marine drowning incidents.

KFD and MSH will continue to use emergency response as the primary strategy to address drowning incidents, but overwhelmingly supported educational programs as the target strategy on community risk reduction for residents and visitors alike.

When taking into account the high rate of visitor drowning deaths on Kauai, strategies must continue to be focused this population segment. As the literature review presented, the ocean safety awareness message needs to up front and personal. Methods of delivery discussed such as face book and twitter, using cell phone updates, travel websites, educational videos and kiosk listing risks and hazards must continually be explored and evaluated because this population segment is constantly changing (Kauai Lifeguard Association, 2010)

Recommendations

The purpose of this research was to conduct a detailed risk assessment of drowning incidents in coastal marine waters surrounding the island of Kauai. These drowning incidents, that the island of Kauai experiences is a preventable occurrence. Effective forms of risk reduction prevention interventions should be based on the 5 E's, education, enforcement, engineering, emergency response and economic benefit (National Fire Administration, 2009). The following recommendations are a direct result of this descriptive research study.

These are the author's recommendations.

Educational

1. Continue to get the ocean safety awareness message out using different delivery methods and vehicles.
2. Continue to form partnerships and alliances with MSH locally and at the state and national level, particularly the visitors industry.
3. Create specific ocean safety awareness messages to address residents and non residents which is the highest "at risk" population segment.
4. Create signage that is site and hazard specific at targeted beaches.

Enforcement

1. Close identified beaches and trail heads during periods of hazardous conditions.
2. Legislating to give arrest powers to county lifeguards to allow lifeguard the authority to remove people from closed beaches.

Engineering

1. Continue to investigate new designs and models in emergency response equipment.
2. Create state wide drowning data base to input drowning statistics in a consistent and detailed system.
3. Continue to evaluate outcomes of near drowning victims whose bodies have been cooled down.

Emergency Response

1. Continue to budget for and support KFD's OSB operations.

2. Requesting in county budget for additional lifeguards.
3. Applying for grant funding to assist in acquiring needed resources.
4. Acquiring county owned helicopter to reduce response times and provide training.
5. Continue to support MSH such as the Kauai Ocean Safety Task Force with programs like the beach rescue tube program.

Economic Benefit

1. Continue risk reduction strategies focused on reducing drowning incidents reduces county liability.
2. Continue risk reduction strategies focused on reducing drowning incidents to helps attract visitors to Kauai.

Recommendations to assist future readers or organizations studying risk reduction on drowning prevention are.

1. Standardize reporting on drowning statistics and data collection.
2. Having input, if possible, from family members of victims to establish risk sequencing.
3. Continue to champion community risk reduction efforts in your own area, as risk reduction begins with you.

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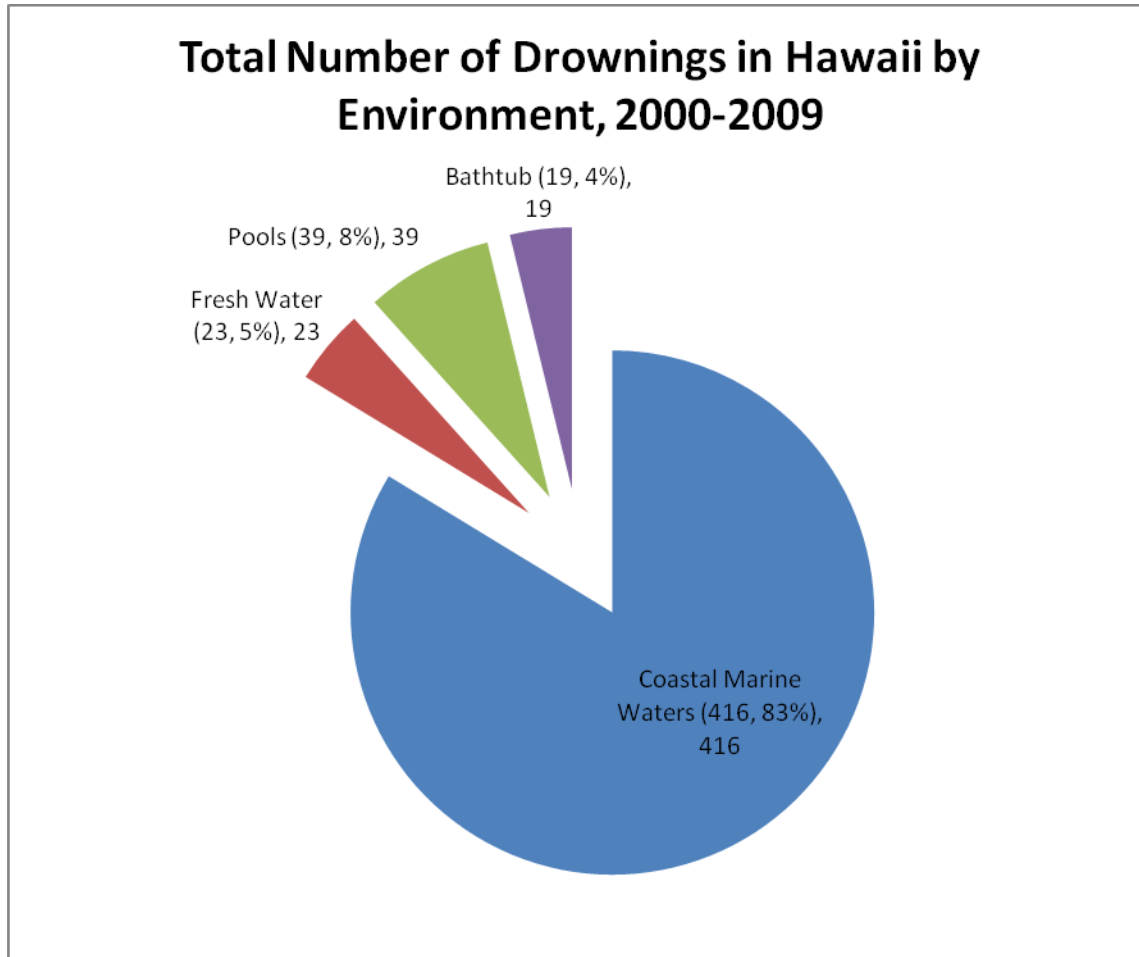
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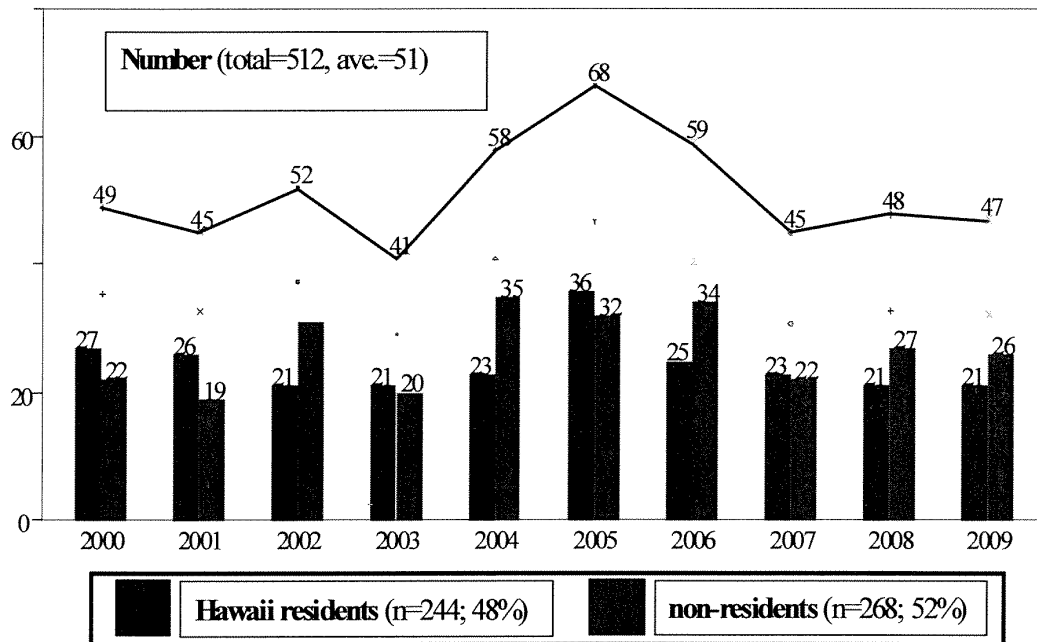
http://www.who.int/violence_injury_prevention/publications/other_injury/en/drowning_factsheet.pdf

Appendix A



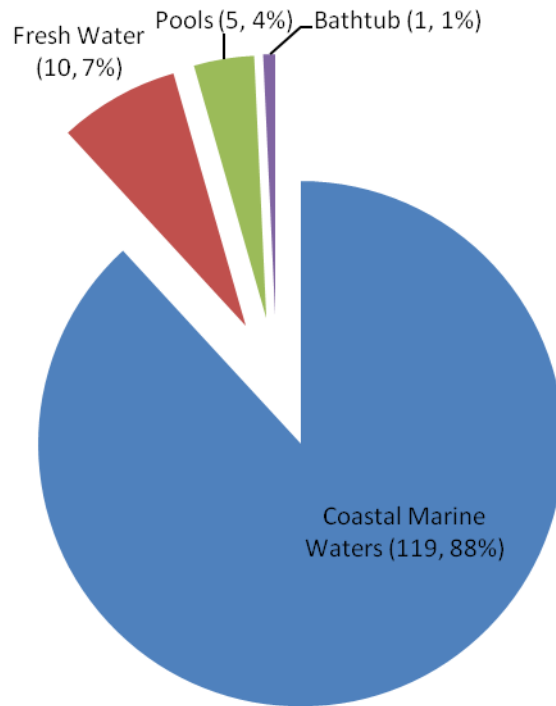
Appendix B

Total number of coastal marine water drownings in Hawaii, 2000-2009



Appendix C

Total Number of Drownings on Kauai by Environment, 2000-2008

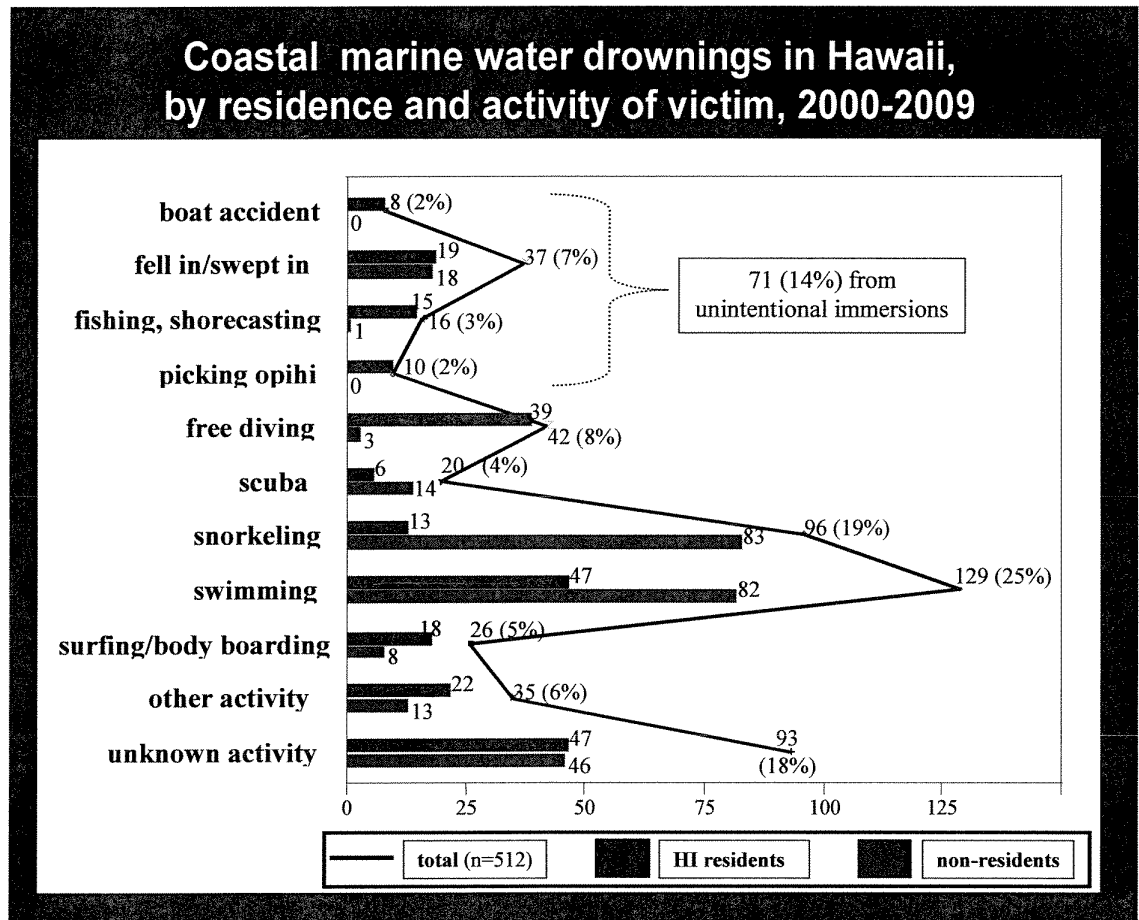


Appendix D

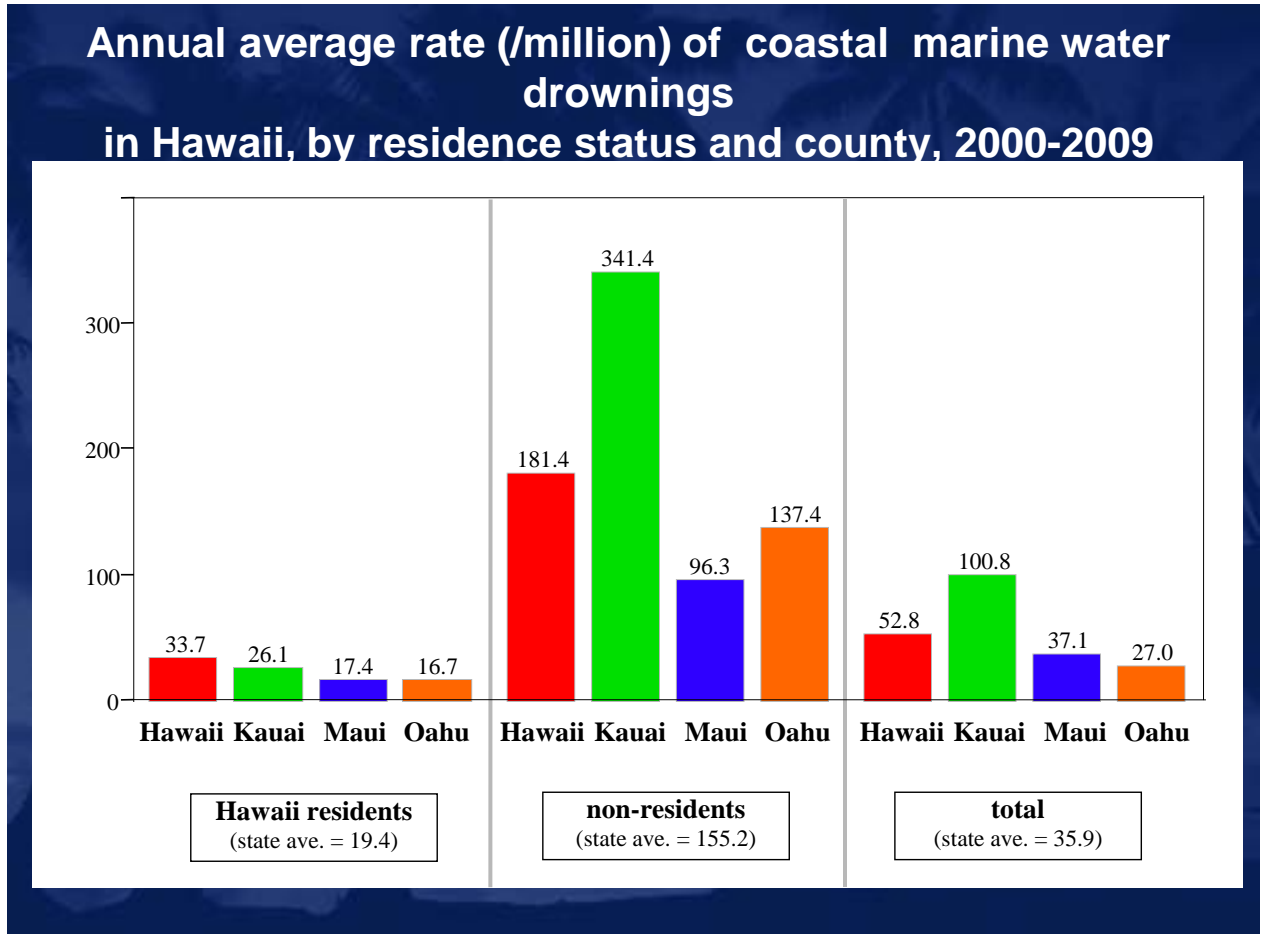
Coastal marine water drownings in Hawaii, 2000-2009

- **Gender:** Mostly (84%) male
- **Age:** Mostly (97%) ages 18 and older
 - *Half (53%) were 40 to 65 years of age*
- **Some seasonality:** 41% from May-August
- **Day of week:** 41% on weekends
 - *48% of drownings among residents*
- **Time of day:** Mostly (81%) daylight (8:30 am- 5:30 pm)
 - *Half (53%) between 10:30 am and 3:30 pm*
 - *Missing for 22% – No data for 2008-2009*

Appendix E



Appendix F



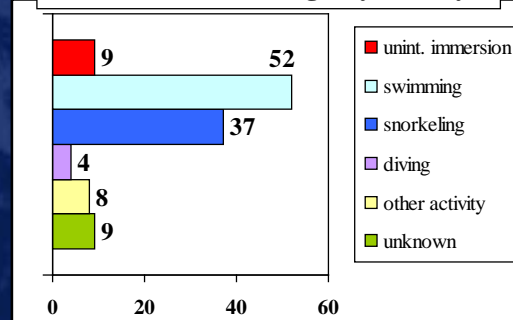
Appendix G

Coastal Marine water drownings on Kauai, 2000-2009

• Summary

- 119 total, 9 to 15 per year
- No consistent trend
- Mostly (87%) non-residents
- Activity: Swimming (44%) and snorkeling (31%)

Number of drownings, by activity



Annual trends,
by residence of victims

